# Space Weather Technical Forecast

Issued on Friday, 24 June 2022 at 13:08 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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## Space Weather Forecast Headline: Slight Chance of an M-class flare. Active electron fluence Likely by UTC new working week. Slight chance of G1/Minor Storms, peaking Saturday 25 June.

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has remained Low over the past 24 hours, with X-ray activity at GOES16 showing only middling C-class flares on a B-class background. These flares were occasional, peaking with a C3.7 from AR3038 at 23/2023UTC. There remain issues with the availability of SDO satellite imagery at present, however there appear to be four sunspots on the visible disc at present. By far the largest remains AR3038 in the northwest, which showed slight areal decay as well as the fading and migrating of its central spots to its leading and trailing groups, the former of which became more symmetric in the 24 hours to finish as an Ehi/Beta. Otherwise, the remaining sunspot groups were all unremarkable.

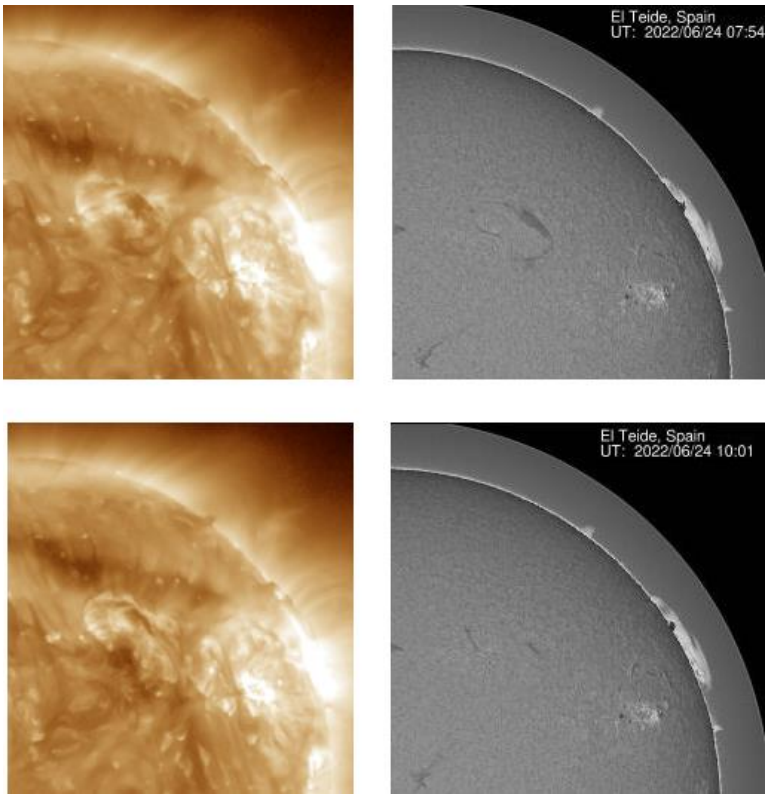


**Figure 0: GOES SUVI 195 and H-alpha imagery of the northwest disc disappearing filament at 24/0800UTC (top) and 24/1000UTC (bottom). Relevant coronagrpah imagery has yet to appear, however this is a recent candidate for an Earth-bound CME should it have left the immediate solar environment.**

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A large filament occupying the northwest disc was seen to become mobile around the UTC dawn period of 24 June, disappearing from (for example El Teide) imagery between 24/0800 and 1000UTC. Coronagraph imagery of this event is awaited. Otherwise, analysis of front side potential Coronal Mass Ejection (CME)-causing events has been somewhat hampered in the past 36 hours or so, however there were a few weak CMEs observed. These remainder have been modelled to the best that available imagery will allow, and currently none are thought to be Earth-directed.

**Solar Wind / Geomagnetic Activity:** The solar wind, as measured by DSCOVR and ACE at L1, showed mature and weak potential coronal hole-like influences, with the phi angle negative (towards the sun) throughout. The solar wind speed showed an erratic tendency between 450-500km/s during the first half of the reporting period, with this evolving to a more decidedly downward trend through the UTC morning of Friday 24 June, approaching 400km/s by the period's end. The solar wind density showed a gradual rising and then falling trend within single figures ppcc over the same interval, while the IMF peaked at 9nT mid-period, with a north-south variation of +/-7nT observed. The Bz component, which had been variable became almost completely co-aligned with Earth's field from 23/2300UTC to limit subsequent geomagnetic activity. The net result of the above measures was a provisional Kp peak of 3o in the 18-21UTC interval, else being Quiet.

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) measured by GOES16 remained at Background levels through the period.

High energy electron flux (greater than 2MeV) peaked at High levels, with 1180pfu observed at GOES16 at 23/1510 UTC. The corresponding 24-hour integrated electron fluence remained below the Active threshold (1e8 integrated pfu) on a fairly steady trend, with an observed fluence of 3.31e7 integrated pfu at 24/0001UTC.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is likely to be Low, with a daily Slight Chance of an isolated M-class flare. AR3038 dominates the disc in terms of flare risk, and only leaves during day four (Monday 27 June). There are no significant returning regions over the eastern limb.

**Solar Wind / Geomagnetic Activity:** No CMEs are currently thought likely to reach Earth. Up to three negative polarity coronal holes (CH93, 94 and/or 95) may bring elevated or perhaps strong wind speeds through the middle of the forecast period, most likely peaking early on day two (Saturday 25 June) with a Slight Chance of G1/Minor Storms. Activity is expected to revert to Quiet by the end of the four-day period.

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event as a result of the large region AR3038 gradually nearing the western limb.

The high energy electron flux (greater than 2 MeV) should show a gradual rising trend in this period. Corresponding electron fluence is therefore expected to develop an eventual rising trend later in the UTC weekend, with Active (1e8 integrated pfu) fluence perhaps becoming Likely by Monday 27 June.

**Figure 1. Solar Analysis Valid 24/0500UTC.**

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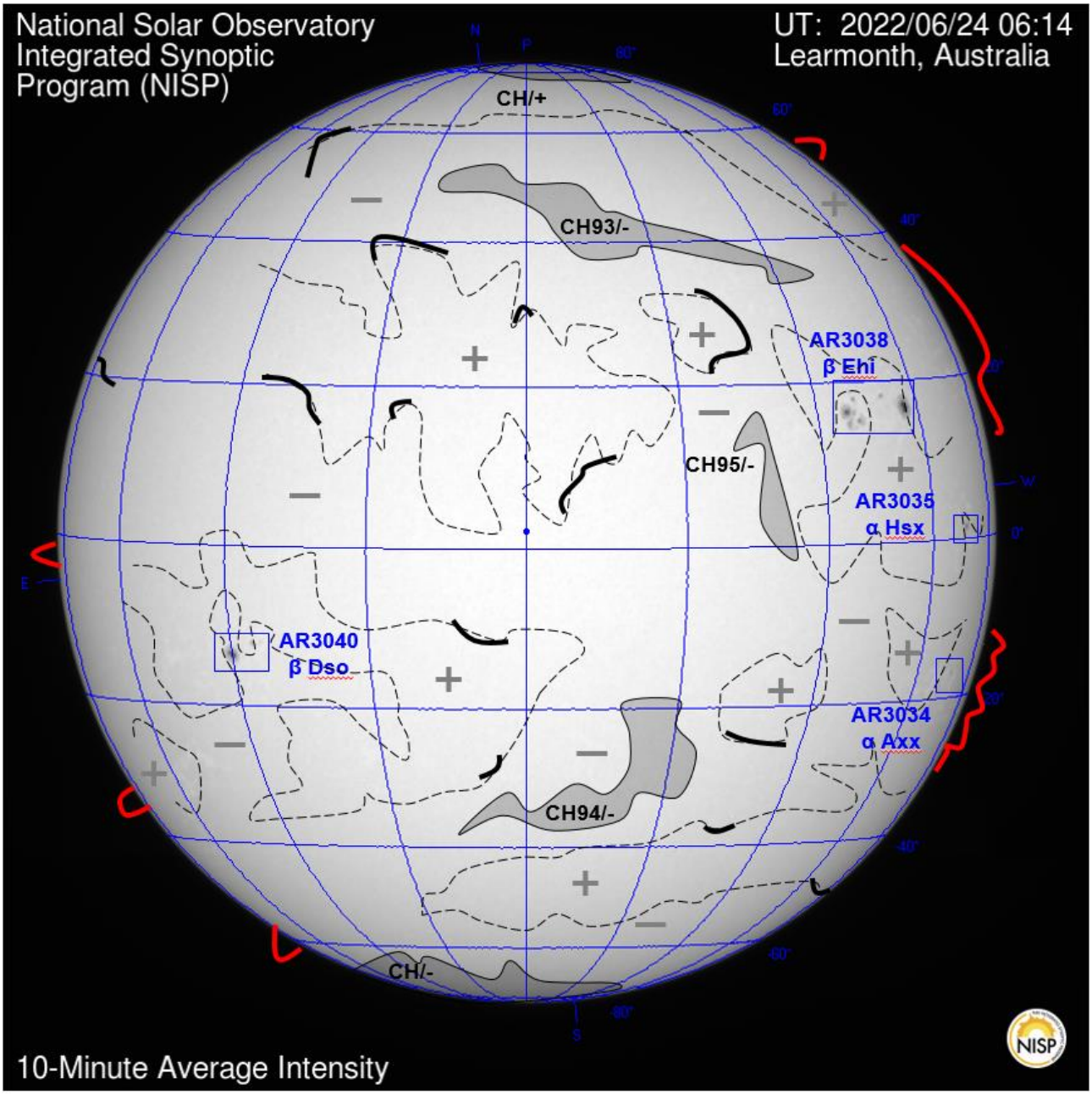
# Met Office Space Weather Technical Forecast




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

No CMEs are currently expected to reach Earth, however confidence in this assertion is lower than usual due to a series of minor disappearing filaments in the past 36 hours and the lower cadence an availability of confirmatory satellite imagery.

There are currently up to three negative polarity coronal holes on the disc (CH93, 94 and 95), however as they cover similar heliographic longitudes, distinguishing between them is not likely to be possible. STEREO A MAG and PLASTIC data are indicative of a reasonable size CIR at a time which would equate to an arrival time at Earth early on day two (Saturday 25 June), whereupon analogous elevated or perhaps strong wind speeds are possible. Having said this, the current geometry of these coronal holes bears little resemblance to the previous rotation, which lowers confidence in the forecast somewhat.

Geomagnetic activity is expected to be Quiet to Unsettled initially, with a peak Slight Chance of G1/Minor Storms on day two, Saturday 25 June. The typically muted geomagnetic response to coronal hole high speed streams near the solstice is the rationale for the relatively low probabilities of G1 in this instance. Activity is expected to become mostly Quiet once again by day four (Monday 27 June).

| Geo-Magnetic Storm | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Minor or Moderate | G1 to G2 | No | 10 | 20 | 5 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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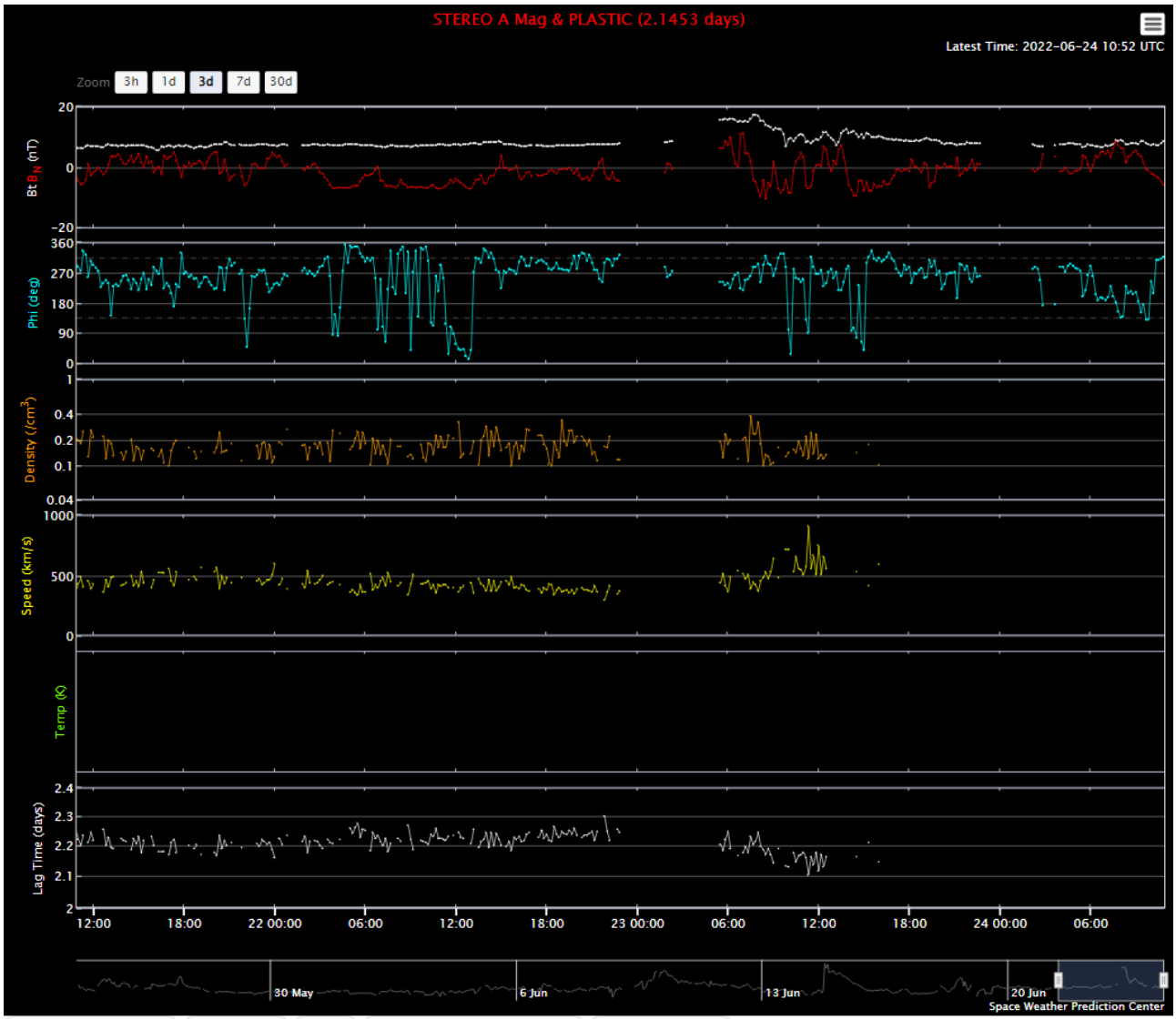
**Figure 2: STEREO A MAG and PLASTIC trace, showing upcoming CIR-like signature (showing e.g. IMF peak near 17nT) that may herald the arrival of one of the series of negative polarity coronal holes, perhaps most likely CH93/- on Saturday 25 June.**

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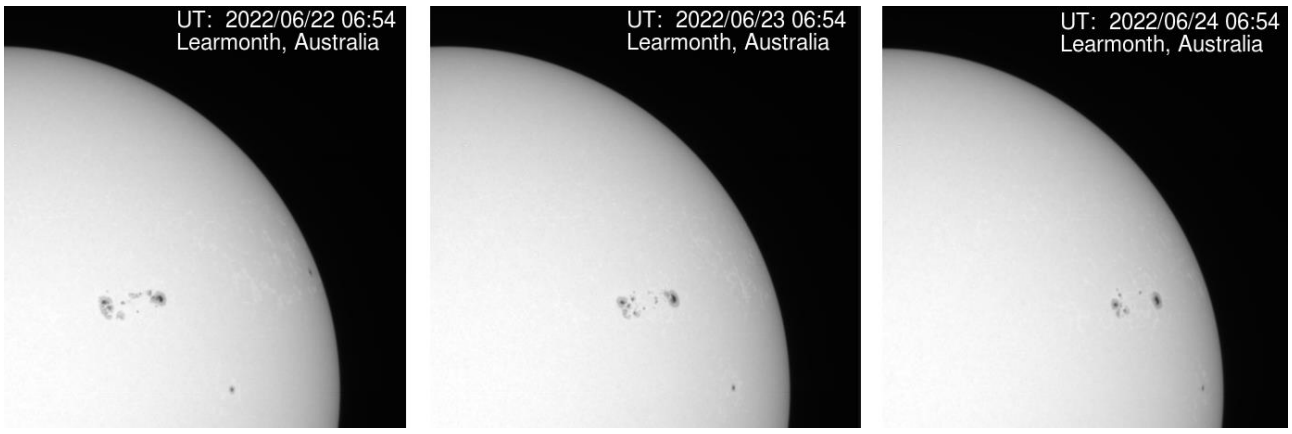
## Radio Blackouts - X-Ray Flares:

There are currently four sunspot regions on the solar disc. By far the largest remains AR3038, which showed a slight declining trend during the last 24 hours, with its area decreasing as its intermediate spots faded, all while its largest penumbra became more symmetric. This spot continues to run counter to expectations with little recent flare activity, however there remains a Slight Chance of M-class activity. All other spots were unremarkable in the past 24 hours.

Overall, no significant new regions are expected to rotate onto the disc in the coming days. AR3038 is expected to leave the disc during day four (Monday 27 June), but will still be in a position to give a continued flare risk until the end of the period, and probabilities therefore remain constant throughout the period.

| X Ray Flares<br>Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | No | 20 | 20 | 20 | 20 |
| Very Active | R3 to R5 X Class | No | 5 | 5 | 5 | 5 |

**Figure 3: Three days' intensitygrams with 24-hour cadence from Learmonth observatory, showing the decaying trend in AR3038 (as well as simpler AR3035 near the solar equator). This trend may go some way toward explaining the observed lack of activity in AR3038, despite its Zurich class.**

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## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and will most likely remain at this level through the period, given the observed lack of activity from the main sunspot region on the disc, AR3038.

There is a nominal slight chance of an S1 or greater event through the next four days with AR3038 in the western hemisphere. However, this region has been somewhat more subdued than its Zurich class implies, with no recent history of large flares or associated proton events.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 5 | 5 | 5 | 5 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) should show a gradual rising trend in the four days, perhaps with some temporary suppression on Saturday 25 June due to geomagnetic activity from a potential CIR from high speed stream arrival(s) from one of up to three negative polarity high speed streams: CH93, 94 and/or CH95.

Corresponding electron fluence is therefore expected to be fairly steady initially, before showing a rising trend through days three and four (26-27 June). 24-hour integrated Active fluence (1e8 integrated pfu) should become Likely by the end of the coming four days as a result. REFM is considered to be showing reasonable guidance at present, with a rise to just below the Active threshold by Day 3, which will likely rise further as its horizon shifts into the current 'day four' of Monday 28 June.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 10 | 10 | 30 | 50 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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